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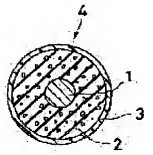
(54) ELECTRICALLY CONDUCTIVE RUBBER ROLL

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain an electrically conductive rubber roll with a low hardness foamed rubber layer almost free from compressive permanent strain by using an electrically conductive foam rubber compsn. contg. EPDM as a rubber base, ADCA as a blowing agent and sulfur as a vulcanizing agent.
SOLUTION: A shaft 1 positioned at the axial center of an electrically conductive rubber roll 4 is made of a metal such as iron, aluminum or stainless steel or an electrically conductive synthetic resin. A foamed rubber layer 2 disposed on the outside of the shaft 1 is formed from a foamed rubber compsn. prepd. by blending an ethylene-propylene-diene terpolymer (EPDM) as a rubber base with an electrically conductive material, azodicarbonamide (ADCA) as a foaming agent and sulfur as a vulcanizing agent. A resistance regulating layer 3 is preferably disposed as the outermost layer of the roll 4. A polymer contg. an electrically conductive material may be used as a material forming the layer 3.



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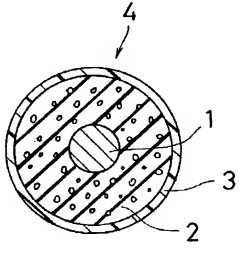
(54)【発明の名称】　導電性ゴムローラ

(57)【要約】
【課題】　導電性ゴムローラの圧縮永久歪を小さくし、画像形成時の画像ムラの発生をなくす。
【解決手段】　感光体に当接して使用される導電性ゴムローラにおいて、導電性ゴム層をゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する組成物を発泡・硬化して形成する。



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【特許請求の範囲】

【請求項１】　軸体の外周に同心状に導電性ゴム層を設けて成り、さらに該導電性ゴム層の外周面上に抵抗調整層を設けてもよい、感光体に当接して使用される導電性ゴムローラにおいて、前記導電性ゴム層は、発泡ゴムから成り、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する組成物を発泡硬化させて得られることを特徴とする導電性ゴムローラ。

【請求項２】　軸体の外周に同心状に導電性ゴム層を設けて成り、さらに該導電性ゴム層の外周面上に抵抗調整層を設けてもよい、感光体に当接して使用される導電性ゴムローラにおいて、前記導電性ゴム層は、少なくとも２層から成り、該２層のゴム層のうち、外側層（感光体側）が非発泡ゴムから成り、内側層（軸体側）が発泡ゴムから成り、該発泡ゴムが、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する組成物を発泡硬化させて得られることを特徴とする導電性ゴムローラ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子写真装置等の画像形成装置に用いられるゴムローラ、特に感光体に当接して使用される導電性ゴムローラに関する。

【０００２】

【従来の技術】複写機およびレーザビームプリンタ等の電子写真装置は、一般にドラム状の感光体（感光ドラム）を備えており、感光ドラムに帯電、露光を行って、感光ドラム上に静電潜像を形成し、その潜像にトナーを付着させて現像し、ついで感光ドラム上のトナーを記録用紙等の記録媒体に転移させて転写し、その後、感光ドラムを所定の電位に除電するとともに感光ドラム上に残留するトナーを清掃し、新たな帯電露光が開始される。転写によって記録媒体に担持されたトナーは、溶融、圧着されて記録媒体に定着され、これにより一連の記録作業が完了する。前記の各工程を実施するために、感光ドラムの周りに帯電ローラ、現像ローラ、転写ローラ、除電（クリーニング）ローラが配置される。帯電ローラは、感光ドラムをその帯電領域に所定電位を付与し、現像ローラは、トナーを感光ドラムに搬送し、転写ローラは転写領域に搬送されてきた記録媒体にトナー像を転写し、除電ローラは転写後の感光ドラムの帯電領域を一定電位に均一化させるとともに転写残りトナー等の残留付着物を感光ドラムから除去する。ただし、近年、除電（クリーニング）ローラの代わりにクリーニングブレードが採用されてきている。これらローラは、通常、導電性軸体と、導電性弾性層（ゴムまたはポリウレタン等のポリマー）から成り、あるいはさらにローラの電気抵抗調整および感光ドラムや記録媒体の汚染防止のために前記弾性層を被覆する抵抗調整層を備えるものもある。

【０００３】このような導電性ローラは、感光ドラムに

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当接して使用されるのが常であり、特に帯電ローラは、加圧バネ等で感光ドラム方向へ押圧付勢させて、感光ドラム面に所定の押圧力で圧接されている。

【０００４】

【発明が解決しようとする課題】導電性ローラが感光ドラムに当接、または圧接された状態が長期間続くと、ローラ（特にニップ部）に圧縮永久歪（ヘタリとも言う）が生じる。この傾向は、導電性ローラが発泡ゴムで構成されているときに顕著である。圧縮永久歪が悪化すると、ヘタリのある場所で、ローラの変形による画像ムラの発生という問題が生じる。

【０００５】本発明は、このような事情に鑑みなされたもので、低硬度で圧縮永久歪の少ない発泡ゴム層を備える導電性ローラ、およびこのようなゴム層を形成し得る導電性発泡ゴム組成物の提供を目的とする。

【０００６】

【課題を解決するための手段】上記の目的を達成するために、本発明の導電性ローラは、軸体の外周に同心状に導電性ゴム層を設けて成り、さらに該導電性ゴム層の外周面上に抵抗調整層を設けてもよい、感光体に当接して使用される導電性ゴムローラであって、前記導電性ゴム層は、発泡ゴムから成り、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する組成物を発泡硬化させて得られることを特徴とする。

【０００７】また、本発明の導電性ローラは、軸体の外周に同心状に導電性ゴム層を設けて成り、さらに該導電性ゴム層の外周面上に抵抗調整層を設けてもよい、感光体に当接して使用される導電性ゴムローラであって、前記導電性ゴム層は、少なくとも２層から成り、該２層のゴム層のうち、外側層（感光体側）が非発泡ゴムから成り、内側層（軸体側）が発泡ゴムから成り、該発泡ゴムが、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する組成物を発泡硬化させて得られることを特徴とする。

【０００８】さらに、本発明の導電性発泡ゴム組成物は、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する。

【０００９】本発明者らは、圧縮永久歪が生じない発泡ゴム層を得るために、ゴム基材としてＥＰＤＭ、発泡剤としてＡＤＣＡ、加硫剤として硫黄を含有する導電性発泡ゴム組成物を用意し、これを発泡硬化させて、軸体の外周に発泡ゴム層または導電性ゴム層内の発泡層を形成すると、ローラの圧縮永久歪がほとんど生じないことを見出し本発明に到達した。

【００１０】

【発明の実施の形態】以下に本発明を図面を参照してさらに詳しく説明する。

【００１１】図１に、本発明の第１の実施の形態である導電性ゴムローラの一例を断面図で示す。図中、１は軸体、２は発泡ゴム層、３は抵抗調整層、４は導電性ゴム

ローラを表す。

【００１２】導電性ゴムローラ４の軸心に位置する軸体１は、たとえば鉄やアルミニウム、各種ステンレス鋼等の金属や導電性を有する合成樹脂から成る。

【００１３】軸体１の外周に設けられる発泡ゴム層２は、ゴム基材に導電材、発泡剤、加硫剤を配合した発泡ゴム組成物から形成する。本発明で用いるゴム基材は、エチレンープロピレンージエン三元共重合体（ＥＰＤＭ）である。

【００１４】発泡ゴム組成物に配合する導電材としては、カーボンブラック、黒鉛、金属、導電性の金属酸化物（酸化錫、酸化チタン）の導電性粉体やカーボンファイバ、金属酸化物の短繊維等の各種導電性繊維を用いることができる。導電材の配合量は、ゴム基材１００重量部（以下「部」と略す）に対して５～８０部に設定するのが好ましい。

【００１５】前記発泡剤としては、アゾジカルボンアミド（ＡＤＣＡ）を用いる。発泡剤の配合量としては、ゴム基材１００部に対して０．５～１５部の範囲に設定することが好ましい。

【００１６】本発明において、加硫剤として硫黄を使用する。そして、前記発泡ゴム組成物には、上記材料以外に、加硫促進剤、軟化剤、可塑剤、補強剤、老化防止剤、帯電防止剤等の添加剤を適宜配合することができる。

【００１７】本発明の導電性ゴムローラ４の最外周には、抵抗調整層３が設けられることが好ましい。この抵抗調整層３の形成材料としては、導電材を含む高分子材料が挙げられる。高分子材料としては、Ｎ－メトキシメチル化ナイロン（８－ナイロン）、ウレタン等である。使用できる導電材は、前述のものの中で特にカーボンブラックが好ましい。この抵抗調整層３は、導電性ゴムローラ４の電気抵抗を適正な範囲に制御し、ローラに耐電圧性（耐リーク性）を付与する。さらに抵抗調整層３は、導電性ゴムローラ４の最外層を構成し、ローラの内側から軟化剤、可塑剤等の滲出しを防ぎ、当接する感光ドラムに対する粘着を防止する。

【００１８】本発明の特徴は、導電性発泡ゴム組成物がゴム基材ＥＰＤＭ、発泡剤ＡＤＣＡ、加硫剤硫黄の組合わせから成ることであり、特に発泡剤としてＡＤＣＡを使用することである。ＡＤＣＡ以外の公知の発泡剤、たとえばＯＢＳＨ（４，４’－オキシビスベンゼンスルホニルヒドラジッド）を用いると、発泡ゴム組成物を加熱加硫するときに発泡剤が加硫を阻害する。したがって、ゴムの架橋密度が低下し、形成される発泡ゴム層の圧縮永久歪が大きくなる。本発明では、ＡＤＣＡを採用することによりこのような問題を回避できた。

【００１９】図２に、本発明の第２の実施の形態である導電性ゴムローラの一例を断面図で示す。図中、１は軸体、３は抵抗調整層、５ａは発泡ゴム層、５ｂは非発泡ゴム層、６は導電性ゴムローラを表す。

【００２０】導電性ゴムローラ６と、図１に示す導電性ゴムローラ４との相違は、導電性ゴム層がゴムローラ６の場合２層から成る（２層以上でもよい）ことであり、それ以外は実質的に両者同一であるので各部の説明については省略する。ここで、２層とは、２層とも発泡ゴム、あるいは非発泡ゴムと発泡ゴムのいずれの場合も含まれるが、後者の方が、特に２層のゴム層のうち内側層（軸体側）が発泡ゴムから成り、外側層（感光体側）が非発泡ゴムから成るのが好ましい。したがって、図２に示す導電性ゴムローラ６では、内側層が発泡ゴム層５ａ、外側層が非発泡ゴム層５ｂから成る構成を有する。

【００２１】本発明の実施の第１の形態に従う導電性ゴムローラ４は、たとえば、導電性発泡ゴム組成物から次のようにして得られる。すなわち、軸体１の外周面に導電性発泡ゴム組成物をチューブ状に押出し成形した後、軸体１を嵌挿する。ついで円筒形状のキャビティを有する金型に設置し、加熱して発泡、加硫する。ついで抵抗調整層３の形成材料を配合混合して、これを有機溶媒に溶解させる。この溶液を、前記の発泡層外表面にディップ法、ローラコート法、スプレコーティング法等によって塗工し、乾燥させ抵抗調整層３を形成し、図１に示すような導電性ゴムローラ４を製造することができる。

【００２２】本発明の実施の第２の形態に従う導電性ゴムローラ６は、たとえば特開平７－２９５３３１に開示されているように、様々な押出成形方法によって製造される。これらのうち特に好適な押出成形方法は、共押出が可能な押出成形機を用い、内側の発泡ゴム層５ａを形成する発泡ゴム組成物と、外側の非発泡ゴム層５ｂを形成するゴム組成物とを同時に押出し、軸体１の外周に２層のゴム層が形成された連続した円筒状の積層体を得る方法である。このような積層体を所定の長さに切断し、円筒形状のキャビティを有する金型に配置する。その後、加熱による加硫、発泡を行って、内側の発泡ゴム層５ａ、外側の非発泡ゴム層５ｂ、および芯金１を一体化させ、金型の内周面に沿った形状を有する目的の導電性ローラを得る。さらに、この導電性ローラの外周面に、前述のようにして抵抗調整層３を形成すると、図２に示すような導電性ゴムローラ６を製造することができる。

【００２３】なお、非発泡ゴム層５ｂを形成するのに用いる非発泡ゴム組成物としては、発泡剤ＡＤＣＡが配合されていない前記発泡ゴム組成物を用いてもよいが、別途非発泡ゴム組成物を調製して用いることができる。この目的のために使用されるゴム基材はＥＰＤＭに制限されず、ニトリルブタジエンゴム、クロロプレンゴム、イソプレンゴム、スチレンブタジエンゴム、エチレンプロピレンゴム、イソプレンゴム、ポリノルボルネンゴム等、通常のゴムまたはスチレンーブタジエンスチレンゴム（ＳＢＳ）、あるいはその水添加物（ＳＥＢＳ）等の可塑性ゴムを挙げることができる。

【００２４】本発明の導電性ゴムローラは、帯電ローラに適用するのが最適であるが、電子写真装置内で感光体に当接して使用される現像ローラ、転写ローラ、除電ローラ等にも使用可能である。

【００２５】本発明のゴムローラ４，６が帯電ローラとして使用される場合、ローラに要求される電気特性に応じて、発泡ゴム組成物あるいは非発泡ゴム組成物に配合される導電材の量が決定されるが、望ましい帯電ローラとしてはローラの抵抗値が10^3～10^7Ω、ゴム層の体積抵抗率は10^1～10^{13}Ω・ｃｍである。

【００２６】実施例および比較例を用いて、本発明の実施の形態をさらに説明するが、これらは本発明の範囲を限定するものではない。すべての部は特に示す以外、重量基準である。

【００２７】（実施例１）ＥＰＤＭ１００部に対して、カーボンブラック６０部、発泡剤アゾジカルボンアミド（ＡＤＣＡ）１５部、その他加硫剤硫黄等の添加剤を適宜配合して、オープンロールで混練し、発泡ゴム組成物を調製した。この発泡ゴム組成物をダイを用いて押出し、円筒のローラ素材を作成した。これに芯金（直径６ｍｍ、長さ２５０ｍｍのステンレス丸棒）を通し円筒金型内で、加熱処理（２００℃、２０分間）を行い、発泡加硫し、芯金の外周に導電性発泡ゴム層を形成して本発明の導電性ゴムローラを得た。発泡ゴム層２の寸法は層厚３ｍｍ、長さ２３０ｍｍであった。ゴム組成物の仕込み量は、芯金と金型の容積を１００としたとき３０容積％であった。前記導電性発泡ゴム層の硬度はアスカーＣ３０°であり、また本実施例の導電性ゴムローラの体積抵抗値は10^5Ω・ｃｍであった。

【００２８】（実施例２）実施例１で得られたローラの表面を溶剤で洗浄した。これをさらに、ウレタン塗布液（レザミンＭＥ－３１１９　１００部；カーボンブラック　ＡＴＬ８７９４　４０部；メチルエチルケトン　９１部；ジメチルフォルムアミド　４９部）に浸漬し、浸漬後、室温で乾燥させ、発泡ゴム層の外周面上に約１００μｍの厚みを有する抵抗調整層３を形成して、本発明の導電性ゴムローラを得た。

【００２９】（実施例３）ＥＰＤＭ１００部に対して、カーボンブラック６０部、発泡剤アゾジカルボンアミド（ＡＤＣＡ）１５部、その他加硫剤硫黄等の添加剤を適宜配合して、オープンロールで混練し、内側層用の発泡ゴム組成物を調製した。続いて、前記組成物中、発泡剤ＡＤＣＡを配合しなかった外側層用の非発泡ゴム組成物を調製した。調製された２種類のゴム組成物を２色押出成形機により一体的に押出成形を行い、一方成形機の口金の略中央部から芯金（直径６ｍｍ、長さ２５０ｍｍのステンレス丸棒）を送出し、内側層、外側層の２層と芯金から成る成形体を得た。

【００３０】円筒金型内で、この成形体の加熱処理（２００℃、１時間）を行い、発泡加硫させ、芯金とにゴム層を一体化成形して、ローラを得た。その後、金型を室温まで冷却し、成形体ローラを取出し、溶剤でローラ表面を洗浄した。これをさらに、所定量のカーボンブラックを含有する実施例２で使用したウレタン塗布液に浸漬し、浸漬後、室温で乾燥させ、非発泡ゴム層５ｂの外周面上に約１００μｍの厚みを有する抵抗調整層３を形成して、本発明の導電性ゴムローラを得た。

【００３１】（比較例１）天然ゴム１００部に対して、カーボンブラック６０部、発泡剤ＯＢＳＨ１５部、その他加硫剤、硫黄等の添加剤を適宜配合して、オープンロールで混練し、発泡ゴム組成物を調製した。この組成物を用いて実施例１の方法と同様にして導電性ゴムローラを製造した。

【００３２】（比較例２）ＥＰＤＭ１００部に対して、カーボンブラック６０部、発泡剤ＯＢＳＨ１５部、その他加硫剤、硫黄等の添加剤を適宜配合して、オープンロールで混練し、発泡ゴム組成物を調製した。この組成物を用いて実施例１の方法と同様にして導電性ゴムローラを製造した。

【００３３】（比較例３）ＥＰＤＭ１００部に対して、カーボンブラック６０部、発泡剤ジニトロソペンタメチレンテトラミン（ＤＰＴ）１５部、その他加硫剤、硫黄等の添加剤を適宜配合して、オープンロールで混練し、発泡ゴム組成物を調製した。この組成物を用いて実施例１の方法と同様にして導電性ゴムローラを製造した。

【００３４】（比較例４）ＥＰＤＭ１００部に対して、カーボンブラック６０部、発泡剤ＯＢＳＨ１５部、その他加硫剤、パーオキサイド等の添加剤を適宜配合して、オープンロールで混練し、発泡ゴム組成物を調製した。この組成物を用いて実施例１の方法と同様にして導電性ゴムローラを製造した。

【００３５】圧縮永久歪の評価

前記実施例および比較例から得られた各導電性ゴムローラの両端に５００ｇの荷重を掛けて、３０ｍｍの外径を有する感光体に圧接させ、その状態で（４０℃、３日間）放置してヘタリ量を測定した。

【００３６】図３は、このような圧縮永久歪の評価試験を模式的に示す。図中、１０は導電性ゴムローラ、１１は感光ドラムを表す。ヘタリ量は図４に示されるようにローラの外周部のへこみを試験前と比べて測定したものである。

【００３７】上記評価試験の結果を表１に示す。

【００３８】

【表１】

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	ヘタリ（μｍ）
実施例１	５２
比較例１	２８０
比較例２	２５０
比較例３	２１０
比較例４	１８０

【００３９】（参考例）実施例１で用いたＡＤＣＡを含有する発泡ゴム組成物と比較例１で用いたＯＢＳＨを含有する発泡ゴム組成物の各々について、レオメータ（ＭＤＲ２０００）中、加硫試験（１６０℃）を行いトルク－時間曲線（加硫曲線）を記録した。その結果、図５に示すような加硫曲線が得られた。ＯＢＳＨを発泡剤とする比較例１の発泡ゴム組成物では、加硫時間１０分経過後に、最大トルクを記録し、それ以上加硫が進まない。一方、ＡＤＣＡを発泡剤とする実施例１の発泡ゴム組成物では、２０分経過後に最大トルクを記録し、この最大値は、比較例１の発泡ゴム組成物の最大トルク値よりはるかに大きい。したがって、比較例１の発泡ゴム組成物では、ＯＢＳＨの発泡が加硫の進行を著しく阻害し、加硫度が充分に上昇していない。

【００４０】

【発明の効果】以上のように本発明によれば、導電性ゴム層を発泡剤ＡＤＣＡ、ゴム基材ＥＰＤＭ、加硫剤硫黄を含有する発泡ゴム組成物から発泡形成したので、ヘタリ量の少ない、圧縮永久歪において、優れたローラ材が得られる。したがって、本発明の導電性ゴムローラを用いて画像形成すると、画像ムラが発生したりしない。

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【００４１】また、本発明の導電性ゴムローラは、圧縮永久歪が小さいので振動吸収特性がよく、使用時に帯電音の発生が抑制され得る。さらに、ローラの内側から不純物が滲出したり（ブリードアウト）せず、良好な画像が得られる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態に従う導電性ゴムローラの断面図である。

【図２】本発明の第２の実施の形態に従う導電性ゴムローラの断面図である。

【図３】圧縮永久歪測定試験を説明するための模式的な斜視図である。

【図４】ヘタリ量の定義を説明する略図である。

【図５】レオメータを用いて求めた加硫曲線を示すグラフ図である。

【符号の説明】

１　軸体

２，５ａ　発泡ゴム層

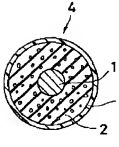
３　抵抗調整層

４，６，１０　導電性ゴムローラ

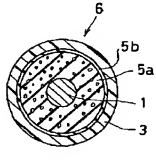
５ｂ　非発泡ゴム層

１１　感光ドラム

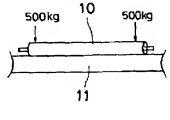
【図１】



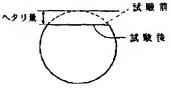
【図２】



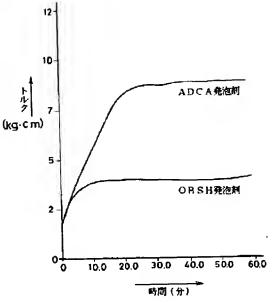
【図３】



【図４】



【図５】


12
10
7
5
2
0
トルク
(kg·cm)
ADCA発泡剤
ORSH発泡剤
0
10.0
20.0
30.0
40.0
50.0
60.0
時間（分）

* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] It is the conductive rubber roller characterized by for the aforementioned conductive rubber layer to consist of a foamed rubber in the conductive rubber roller which may prepare a conductive rubber layer in the periphery of an axis in the shape of the said heart, may grow into it, and may prepare a resistance adjustment layer on the peripheral face of this conductive rubber layer further, and which is used in contact with a photo conductor, to carry out foaming hardening of the constituent [ADCA] with which contain as EPDM and a foaming agent and it contains sulfur as a vulcanizing agent as a rubber base material, and to be

[Claim 2] In the conductive rubber roller which may prepare a conductive rubber layer in the periphery of an axis in the shape of the said heart, may grow into it, and may prepare a resistance adjustment layer on the peripheral face of this conductive rubber layer further and which is used in contact with a photo conductor The aforementioned conductive rubber layer consists of two-layer at least. The inside of this two-layer rubber layer, The conductive rubber roller characterized by for an outside layer (photo conductor side) consisting of a non-foamed rubber, and for an inside layer (axis side) consisting of a foamed rubber, carrying out foaming hardening of the constituent with which this foamed rubber contains ADCA as EPDM and a foaming agent, and it contains sulfur as a vulcanizing agent as a rubber base material, and being obtained.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the rubber roller used for image formation equipments, such as electrophotography equipment, especially the conductive rubber roller used in contact with a photo conductor.
[0002]
[Description of the Prior Art] Electrophotography equipments, such as a copying machine and a laser beam printer Generally have the drum-like photo conductor (photoconductor drum), and it is charged in a photoconductor drum. Expose, form an electrostatic latent image on a photoconductor drum, make a toner adhere to the latent image, and negatives are developed. Subsequently, the toner on a photoconductor drum is transferred to record media, such as a record form, and it imprints, while discharging a photoconductor drum to predetermined potential after that, the toner which remains on a photoconductor drum is cleaned, and new electrification exposure is started. By imprint, the toner supported by the record medium is fused and stuck by pressure, a record medium is fixed to it, and, thereby, a series of record work completes it. In order to carry out each aforementioned process, an electrification roller, a developing roller, an imprint roller, and an electric discharge (cleaning) roller are arranged around a photoconductor drum. An electrification roller gives predetermined potential to the electrification field for a photoconductor drum, a developing roller conveys a toner to a photoconductor drum, an imprint roller imprints a toner image to the record medium conveyed to the imprint field, and an electric discharge roller removes remains affixes, such as the imprint remaining toner, from a photoconductor drum while making fixed potential equalize the electrification field of the photoconductor drum after an imprint. However, the cleaning blade has been adopted instead of an electric discharge (cleaning) roller in recent years. These rollers also have a thing equipped with the resistance adjustment layer which consists of a conductive axis and a conductive elastic layer (polymer, such as rubber or polyurethane), or usually covers the aforementioned elastic layer further for electric resistance adjustment of a roller and the pollution control of a photoconductor drum or a record medium.
[0003] It is a usual state that such a conductive roller is used in contact with a photoconductor drum, it carries out press energization especially of the electrification roller in the direction of a photoconductor drum with a pressurization spring etc., and the pressure welding is carried out to the photoconductor drum side by the predetermined press force.
[0004]
[Problem(s) to be Solved by the Invention] If contact or the state where the pressure welding was carried out follows [a conductive roller] a photoconductor drum for a long period of time, a compression set (it is also called a permanent set in fatigue) will arise on a roller (especially nip section). This inclination is remarkable when the conductive roller consists of foamed rubbers. Aggravation of a compression set produces the problem of generating of the picture nonuniformity by deformation of a roller in a place with a permanent set in fatigue.
[0005] this invention was made in view of such a situation, and aims at offer of the conductive roller equipped with a foamed-rubber layer with few compression sets by the low degree of hardness, and the conductive foamed-rubber constituent which can form such a rubber layer.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the conductive roller of this invention A conductive rubber layer may be prepared in the periphery of an axis in the shape of the said heart, it may grow into it, and a resistance adjustment layer may be further prepared on the peripheral face of this conductive rubber layer. It is characterized by being the conductive rubber roller used in contact with a photo conductor, and for the aforementioned conductive rubber layer consisting of a foamed rubber, carrying out foaming hardening of the constituent with which contain ADCA as EPDM and a foaming agent and it contains sulfur as a vulcanizing agent as a rubber base material, and being obtained.
[0007] Moreover, the conductive roller of this invention prepares a conductive rubber layer in the periphery of an axis in the shape of the said heart, and grows into it. Furthermore, it is the conductive rubber roller which may prepare a resistance adjustment layer on the peripheral face of this conductive rubber layer and which is used in contact with a photo conductor. the aforementioned conductive rubber layer Consist of two-layer at least and an outside layer (photo conductor side) consists of a non-foamed rubber among these two-layer rubber layers. It is characterized by for an inside layer (axis side) consisting of a foamed rubber, carrying out foaming hardening of the constituent with which this foamed rubber contains ADCA as EPDM and a foaming agent, and it contains sulfur as a vulcanizing agent as a rubber base material, and being obtained.
[0008] Furthermore, as a rubber base material, the conductive foamed-rubber constituent of this invention contains ADCA as EPDM and a foaming agent, and contains sulfur as a vulcanizing agent.
[0009] In order that this invention persons might get the foamed-rubber layer which a compression set does not produce, when the conductive foamed-rubber constituent which contains ADCA as EPDM and a foaming agent and contains sulfur as a vulcanizing agent as a rubber base material was prepared, foaming hardening of this was carried out and the foaming layer in a foamed-rubber layer or a conductive rubber layer was formed in the periphery of an axis, it found out that the compression set of a roller hardly arose, and this invention was reached.
[0010]

[Embodiments of the Invention] this invention is explained in more detail with reference to a drawing below.
[0011] A cross section shows an example of the conductive rubber roller which is the form of operation of the 1st of this invention to drawing 1 . In an axis and 2, a foamed-rubber layer and 3 express a resistance adjustment layer, and 4 expresses [the inside of drawing, and 1] a conductive rubber roller.
[0012] The axis 1 located in the axial center of the conductive rubber roller 4 consists of the synthetic resin which has metals, such as iron, and aluminum, various stainless steel, and conductivity.
[0013] The foamed-rubber layer 2 prepared in the periphery of an axis 1 is formed from the foamed-rubber constituent which blended electric conduction material, the foaming agent, and the vulcanizing agent with the rubber base material. The rubber base material used by this invention is an ethylene-propylene-diene ternary polymerization object (EPDM).
[0014] As electric conduction material blended with a foamed-rubber constituent, various conductive fiber, such as a staple fiber of carbon black, a graphite, a metal, conductive fine particles and the carbon fiber of a conductive metallic oxide (a tin oxide, titanium oxide), and a metallic oxide, can be used. As for the loadings of electric conduction material, it is desirable to set it as the five to 80 section to the rubber base-material 100 weight section (for it to abbreviate to the "section" below).
[0015] An AZOJI carvone amide (ADCA) is used as the aforementioned foaming agent. It is desirable to set it as the range of the 0.5 to 15 section to the rubber base-material 100 section as loadings of a foaming agent.
[0016] In this invention, sulfur is used as a vulcanizing agent. And additives, such as a vulcanization accelerator, a softener, a plasticizer, a reinforcing agent, an antioxidant, and an antistatic agent, can be suitably blended with the aforementioned foamed-rubber constituent in addition to the above-mentioned material.
[0017] To the outermost periphery of the conductive rubber roller 4 of this invention, it is desirable that the resistance adjustment layer 3 is formed. As a formation material of this resistance adjustment layer 3, the polymeric materials containing electric conduction material are mentioned. As polymeric materials, they are N-methoxymethyl-ized nylon (8-nylon), urethane, etc. The electric conduction material which can be used has desirable carbon black especially in the above-mentioned thing. This resistance adjustment layer 3 controls the electric resistance of the conductive rubber roller 4 in the proper range, and gives withstand-voltage nature (leak-proof nature) to a roller. Furthermore, the outermost layer of drum of the conductive rubber roller 4 is constituted, a softener, a plasticizer, etc. ooze from the inside of a roller, the resistance adjustment layer 3 prevents **, and the adhesion to the contacting photoconductor drum is prevented.
[0018] The feature of this invention is that a conductive foamed-rubber constituent consists of the combination of the rubber base material EPDM, a foaming agent ADCA, and vulcanizing agent sulfur, and is using ADCA especially as a foaming agent. If well-known foaming agents other than ADCA, for example, OBSH, (4 and 4'-oxy-screw benzenesulphonyl HIDORAJIDDO) are used, when carrying out heating vulcanization of the foamed-rubber constituent, a foaming agent will check vulcanization. Therefore, the crosslinking density of rubber falls and the compression set of the foamed-rubber layer formed becomes large. In this invention, such a problem was avoidable by adopting ADCA.
[0019] A cross section shows an example of the conductive rubber roller which is the gestalt of operation of the 2nd of this invention to drawing 2 . In a resistance adjustment layer and 5a, a foamed-rubber layer and 5b express a non-foamed-rubber layer, and 6 expresses [the inside of drawing, and 1 / an axis and 3] a conductive rubber roller.
[0020] what the difference with the conductive rubber roller 6 and the conductive rubber roller 4 shown in drawing 1 consists of two-layer when a conductive rubber layer is a rubber roller 6 (more than two-layer is sufficient) -- it is -- except [it] -- substantial -- both -- since it is the same, it omits about explanation of each part Here, although two-layer is contained in any [of a foamed rubber or a non-foamed rubber, and a foamed rubber] case, as for two-layer, it is desirable that an inside layer (axis side) consists of a foamed rubber among rubber layers two-layer in latter one, and an outside layer (photo conductor side) consists of a non-foamed rubber especially. Therefore, in the conductive rubber roller 6 shown in drawing 2 , an inside layer has the composition to which foamed-rubber layer 5a and an outside layer change from non-foamed-rubber layer 5b.
[0021] The conductive rubber roller 4 according to the 1st gestalt of operation of this invention is obtained for example, from a conductive foamed-rubber constituent as follows. That is, an axis 1 is fitted in after carrying out extrusion molding of the conductive foamed-rubber constituent to the peripheral face of an axis 1 at the shape of a tube. Subsequently, it installs, heats and vulcanizes [foam and] to the metal mold which has a cylindrical shape-like cavity. Subsequently, combination mixture of the formation material of the resistance adjustment layer 3 is carried out, and this is dissolved in an organic solvent. Coating of this solution is carried out to the aforementioned foaming layer outside surface, it can be made to be able to dry it by the dipping method, the roller coat method, the spray coating method, etc., the resistance adjustment layer 3 can be formed, and the conductive rubber roller 4 as shown in drawing 1 can be manufactured.
[0022] The conductive rubber roller 6 according to the 2nd gestalt of operation of this invention is manufactured by the various extrusion-molding methods as indicated by JP,7-295331,A. Among these especially the suitable extrusion-molding method is a method of obtaining the layered product of the continuous shape of a cylinder by which the two-layer rubber layer was formed in the periphery of an axis 1 which extrudes simultaneously the foamed-rubber constituent which forms inside foamed-rubber layer 5a, and the rubber constituent which forms outside non-foamed-rubber layer 5b using the extruding press machine which can be co-extruded. Such a layered product is cut to predetermined length, and it arranges to the metal mold which has a cylindrical shape-like cavity. Then, perform vulcanization by heating, and foaming, inside foamed-rubber layer 5a, outside non-foamed-rubber layer 5b, and rodding 1 are made to unify, and a conductive roller to have the configuration where the inner skin of metal mold was met is obtained. Furthermore, if the resistance adjustment layer 3 is formed in the peripheral face of this conductive roller as mentioned above, the conductive rubber roller 6 as shown in drawing 2 can be manufactured.
[0023] In addition, although the aforementioned foamed-rubber constituent with which the foaming agent ADCA is not blended may be used as a non-foamed-rubber constituent used for forming non-foamed-rubber layer 5b, a non-foamed-rubber constituent can be prepared and used separately. The rubber base material used for this purpose is not restricted to EPDM, but can mention plasticity rubber, such as usual rubber, such as nitril butadiene rubber, chloroprene rubber, polyisoprene rubber, styrene butadiene rubber, an ethylene propylene rubber, polyisoprene rubber, and poly polynorbornene rubber, styrene-butadiene-styrenerubber (SBS), or its water additive (SEBS).
[0024] Although applying to an electrification roller is optimal as for the conductive rubber roller of this invention, it is usable on

the developing roller used in contact with a photo conductor within electrophotography equipment, an imprint roller, an electric discharge roller, etc.

[0025] Although the amount of the electric conduction material blended with a foamed-rubber constituent or a non-foamed-rubber constituent is determined according to the electrical property required of a roller when the rubber rollers 4 and 6 of this invention are used as an electrification roller, as a desirable electrification roller, the resistance of a roller of the volume resistivity of 103-107ohm, and a rubber layer is 101 - 1013 ohm-cm.

[0026] Although the form of operation of this invention is further explained using an example and the example of comparison, these do not limit the range of this invention. Especially all the sections are weight criteria except being shown.

[0027] (Example 1) To the EPDM100 section, additives, such as the carbon black 60 section, the foaming agent AZOJI carvone amide (ADCA) 15 section, and other vulcanizing agent sulfur, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent was prepared. This foamed-rubber constituent was extruded using the die, and the cylindrical roller material was created. this -- rodding (the diameter of 6mm, stainless steel round bar with a length of 250mm) -- a through cylinder -- metal mold -- foaming vulcanization was heat-treated and (for 200 degrees C and 20 minutes) carried out inside, the conductive foamed-rubber layer was formed in the periphery of rodding, and the conductive rubber roller of this invention was obtained The size of the foamed-rubber layer 2 was 230mm in 3mm of thickness, and length. The charge of a rubber constituent was 30 capacity %, when capacity of rodding and metal mold was set to 100. The degree of hardness of the aforementioned conductive foamed-rubber layer was ASUKA C30 degree, and the volume-resistivity values of the conductive rubber roller of this example were 105 ohm-cm.

[0028] (Example 2) The solvent washed the front face of the roller obtained in the example 1. Further, it flooded with urethane application liquid (3119 REZAMIN ME-100 section; 8794 carbon black ATL40 section; methyl-ethyl-ketone 91 section; dimethyl formamide 49 section), this was dried at the room temperature after being immersed, the resistance adjustment layer 3 which has the thickness of about 100 micrometers was formed on the peripheral face of a foamed-rubber layer, and the conductive rubber roller of this invention was obtained.

[0029] (Example 3) To the EPDM100 section, additives, such as the carbon black 60 section, the foaming agent AZOJI carvone amide (ADCA) 15 section, and other vulcanizing agent sulfur, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent for inside layers was prepared. Then, the non-foamed-rubber constituent for outside layers which did not blend a foaming agent ADCA was prepared among the aforementioned constituent. 2 color extruding press machine performed extrusion molding for two kinds of prepared rubber constituents in one, on the other hand, rodding (the diameter of 6mm, stainless steel round bar with a length of 250mm) was sent out from the abbreviation center section of the mouthpiece of a making machine, and the Plastic solid which consists of two-layer [of an inside layer and an outside layer] and rodding was obtained.

[0030] Within the circle metallic tube type, this Plastic solid is heat-treated (200 degrees C, 1 hour), foaming vulcanization was carried out, unification fabrication of the rubber layer was carried out at rodding, and the roller was obtained. Then, metal mold was cooled to the room temperature, the Plastic-solid roller was taken out, and the solvent washed the roller front face. Flooded with the urethane application liquid which used this in the example 2 containing the carbon black of the specified quantity further, it was made to dry at a room temperature after being immersed, the resistance adjustment layer 3 which has the thickness of about 100 micrometers was formed on the peripheral face of non-foamed-rubber layer 5b, and the conductive rubber roller of this invention was obtained.

[0031] (Example 1 of comparison) To the natural rubber 100 section, additives, such as the carbon black 60 section, the foaming agent OBSH15 section, other vulcanizing agents, and sulfur, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent was prepared. The conductive rubber roller was manufactured like the method of an example 1 using this constituent.

[0032] (Example 2 of comparison) To the EPDM100 section, additives, such as the carbon black 60 section, the foaming agent OBSH15 section, other vulcanizing agents, and sulfur, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent was prepared. The conductive rubber roller was manufactured like the method of an example 1 using this constituent.

[0033] (Example 3 of comparison) To the EPDM100 section, additives, such as the carbon black 60 section, the foaming agent dinitrosopentamethylenetetramine (DPT) 15 section, other vulcanizing agents, and sulfur, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent was prepared. The conductive rubber roller was manufactured like the method of an example 1 using this constituent.

[0034] (Example 4 of comparison) To the EPDM100 section, additives, such as the carbon black 60 section, the foaming agent OBSH15 section, other vulcanizing agents, and peroxide, were blended suitably, it kneaded with an open roll, and the foamed-rubber constituent was prepared. The conductive rubber roller was manufactured like the method of an example 1 using this constituent.

[0035] The 500g load was imposed on the ends of each conductive rubber roller obtained from the evaluation aforementioned example and the example of comparison of a compression set, the pressure welding was carried out to the photo conductor which has the outer diameter of 30mm, it was left in the state (for 40 degrees C and three days), and the amount of permanent sets in fatigue was measured.

[0036] Drawing 3 shows the evaluation examination of such a compression set typically. Ten express a conductive rubber roller among drawing, and 11 expresses a photoconductor drum. The amount of permanent sets in fatigue measures the crater of the periphery section of a roller compared with examination before, as shown in drawing 4 .

[0037] The result of the above-mentioned evaluation examination is shown in Table 1.

[0038]

[Table 1]

	ヘタリ（μm）
実施例1	52
比較例1	280
比較例2	250
比較例3	210
比較例4	180

[0039] (Example of reference) About each of the foamed-rubber constituent containing ADCA used in the example 1, and the foamed-rubber constituent containing OBSH used in the example 1 of comparison, among the rheometer (MDR2000), the vulcanization examination (160 degrees C) was performed and the torque-time curve (vulcanization curve) was recorded. Consequently, the vulcanization curve as shown in drawing 5 was acquired. In the foamed-rubber constituent of the example 1 of comparison which uses OBSH as a foaming agent, after curing-time 10-minute progress, the maximum torque is recorded and vulcanization does not progress any more. On the other hand with the foamed-rubber constituent of the example 1 which uses ADCA as a foaming agent, the maximum torque is recorded after 20-minute progress, and this maximum is far larger than the maximum torque value of the foamed-rubber constituent of the example 1 of comparison. Therefore, in the foamed-rubber constituent of the example 1 of comparison, foaming of OBSH checks advance of vulcanization remarkably and the vulcanization degree is not fully going up.

[0040]

[Effect of the Invention] Since foaming formation of the conductive rubber layer was carried out as mentioned above from the foamed-rubber constituent containing a foaming agent ADCA, the rubber base material EPDM, and vulcanizing agent sulfur according to this invention, the roller material with few amounts of permanent sets in fatigue which was excellent in the compression set is obtained. Therefore, if image formation is carried out using the conductive rubber roller of this invention, picture nonuniformity will not occur.

[0041] Moreover, since the compression set is small, the conductive rubber roller of this invention has a good oscillating absorption property, and generating of electrification sound may be suppressed at the time of use. Furthermore, an impurity does not ooze out from the inside of a roller and a good picture is acquired.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

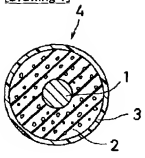
[Brief Description of the Drawings]
[Drawing 1] It is the cross section of the conductive rubber roller according to the gestalt of operation of the 1st of this invention.
[Drawing 2] It is the cross section of the conductive rubber roller according to the gestalt of operation of the 2nd of this invention.
[Drawing 3] It is a typical perspective diagram for explaining a compression-set measurement examination.
[Drawing 4] It is the schematic drawing explaining the definition of the amount of permanent sets in fatigue.
[Drawing 5] It is the graphical representation showing the vulcanization curve searched for using the rheometer.
[Description of Notations]
1 Axis
2 5a Foamed-rubber layer
3 Resistance Adjustment Layer
4, 6, 10 Conductive rubber roller
5b Non-foamed-rubber layer
11 Photoconductor Drum

[Translation done.]

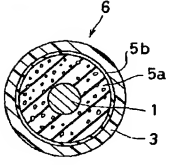
* NOTICES *

DRAWINGS

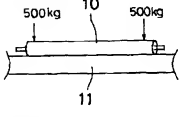
[Drawing 1]



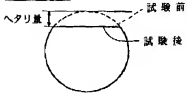
[Drawing 2]



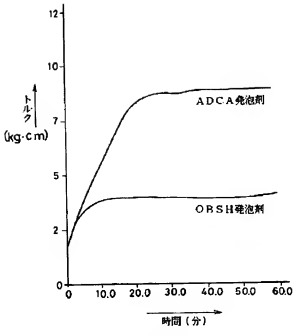
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]